STOPPING MOTHER NATURE

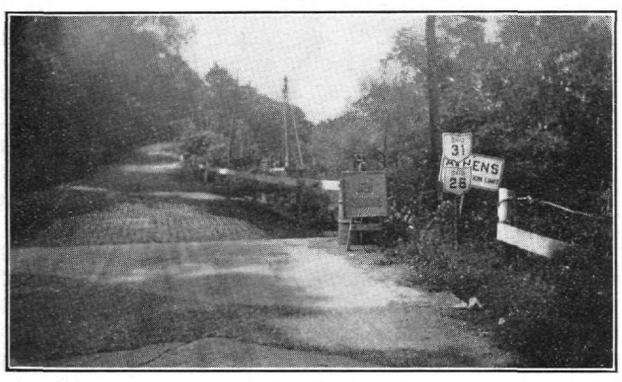
By H. M. SCOTT, '29

Our car stopped with a thud. We had arrived. Here before us was our summer's work. Hastily we climbed from the car and turned to view our prospects for a pleasant summer. Such a sight! Nothing except a barren stretch of uneven cinder-packed roadbed, overgrown in places and slipped over the hill in others, littered here and there with ragged edges of former brick paving. We were discouraged. Such a prospect for the summer.

Soon the initial survey was under way. Clambering over broken culverts, staggering through head-high weeds, up the hillside and over the edge of the slip, at all times surrounded and covered by a dense cinder dust raised by the passing traffic. Soon we were exhausted and more than ready to call it a day. Clambering into our car we headed for town and proceeded as quickly as possible to forget that a road slip had ever existed.

On the first day of the preliminary survey of the slip, which we had viewed with so much disgust the day before, things changed greatly. We came to realize just how large the problem was that we were to buck. We became interested. The dirt and grime were forgotten; even the many trips up and over and down again, which were necessary for a proper inspection of the slip, failed to tire us. We became enthusiastic. We were going to fight, and nature was more than a formidable enemy. For three years efforts to hold any sort of a road on this hillside had failed. Our problem was to prepare a plan of attack—we must replace that roadway—we must stop that slipping. Traffic was being held up; cars were being wrecked; the Highway Department was loaded with inquiries, complaints, and probable suits. We must win.

After several days spent in the seemingly unprofitable work of poking around through weeds, leveling off sections of rock strata in an effort to find hidden springs, we came to the conclusion that the hillside was slipping on top of a rock strata, probably due to the weight of the hill in back pushing upon the roadbed. This condition could be remedied in only two ways: The first, and more improbable one, that of excavating a new roadway through the hillside, besides being



ON LOCATION
The slide with drilling rigs and piling in position.

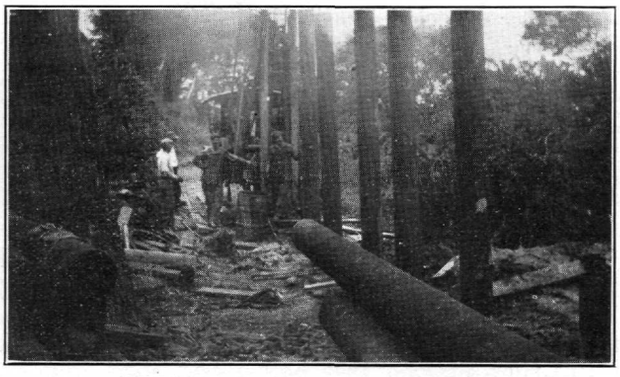


FIG. 2—PLACING UNCUT PILES.

the more costly method, would present many new problems; the second, the use of steel-encased concrete piling, would halt the slip and provide an anchor for the new roadway. This piling was to be set in drilled holes and so spaced as to very effectively prevent further sliding of the hill. This second method was decided upon and work immediately begun on the collection of suitable data.

In order to correctly and properly draw up plans it was found necessary to sink numerous test holes into the rock strata both on and near the site of the slip. These holes determined the depth of the strata, its nature, and whether it would be suitable for foundationing a formation of piles for the holding of the roadbed. This work of drilling test holes and testing and surveying the project consumed several weeks, at the end of which time enough data had been secured to proprly draw up and plan the specifications for the reconstruction. The rock strata was found to be of sandstone structure and capable of holding the hillside against itself.

The main plan of relocation and construction of the roadbed was that a double line of oil-well casing piles, filled with concrete and reinforced with steel, should be put in place to hold the slip. This double line of piles was to be located some forty feet from the center of the relocated road and was to be cut off on a line two feet above the ground level. The roadbed was to be filled in back of the piles but the slide proper was to be loaded with no more surplus earth than was necessary for the roadbed. The piles after being allowed to weather for a given time were reexamined, then, if the slip showed signs of movement, further strengthening by the installation of additional piles was to be employed.

The average length of piling to be used was found to be 26 feet, 8 feet of which was to extend into the rock strata. The sections of steel casing required for piling use were somewhat longer than standard oil-well casing so that the use of an oxy-acetylene welding torch was necessary. Each weld was tested for strength and was generally found much stronger than the pipe proper. With the aid of the welding torch, money could

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be saved by using up small trimmed-off casing ends.

The holes required for the piling were drilled by two portable gasoline rigs. These rigs began drilling from the middle of the double row of piles. The drilling then proceeded out one row and back on the other. The rigs were equipped with hoisting derricks which placed the casings for the piles and provided also easy access and a method for filling them with concrete.

Several smaller additional items of engineering interest were encountered. Th first was a problem of properly fastening reinforcing rods in the piling and keeping them in place during the pouring and setting of the concrete. This was accomplished by the use of a foundry-made jig which was of very heavy structure and circular in shape. This fixture fitted into the top of the casings and held the reinforcing rods but allowed the concrete to flow to the bottom of the pile unobstructed. These jigs were detachable and came in for much use. Next, came the problem of properly seating the pilings at the base of the rig-drilled hole in the rock strata. The hole for the pile was to extend into the rock an average of some seven feet, and it was very necessary to the stability of the pile that a secure anchor in this strata be had. This factor was overcome by burning with the use of the torch, two six-inch-diameter holes in the bottom of each casing. These holes permitted the concrete to flow through and fill up the bottom of the drilled hole and much more closely bind the pile to the rock strata. Also in the case of severely wet weather they assisted in carrying off excess water at the base of piles, which otherwise would have weakened the concrete.

After the piles were completely installed and weathered they were tested and found to be holding the slide in A-1 condition. The work was then turned over to the State Highway Department under the supervision of the County Resident Engineer, who was to carry on the planning for the construction of the roadway over the halted slip.

Though disagreeable in some of its features, this problem of stopping a slip presented many good engineering problems and in the proper correction of the slip experience in a very practical field was obtained. Although not in frequent use as a practical road construction method, this idea of using steel-encased concrete piling can be of great material value to engineers if they must match their powers against those displayed by nature.